CHAPTER 8
TROUBLESHOOTING
LESSON PLAN 8

METHOD:

Conference, demonstration, and practical exercise

TIME ALLOTTED:

1.5 hours

COURSE PRESENTED TO:

a. Tank crews
b. Instructors
c. TSC personnel

TOOLS, EQUIPMENT, AND MATERIALS (Per Tank Crew):

a. M1A2 tank with BII and TWGSS installed
b. TM 9-6920-709-12&P-1-2

PERSONNEL:

a. Primary instructor
b. Assistant instructor

INSTRUCTIONAL AIDS:

a. Overhead projector
b. Viewgraphs (Appendix D)

REFERENCES:

a. TM 9-6920-709-12&P-1-2, Chapters 3 and 4
b. TM 9-2350-288-10-1/2

APPENDICES:

Appendix A. Safety
Appendix B. List of Approved Errors
Appendix C. Test Administration Guide
Appendix D. Viewgraphs

8-1. INTRODUCTION. (5 minutes)

Note. Show Slide 1.

a. **Reason.** TWGSS was designed to be a reliable and durable system, but as with any equipment, it can fail. When TWGSS failures occur, the crew must be able to identify, troubleshoot, and correct the problem.

Note. Show Slide 2.

b. **Training Objective.** Given an operational M1A2 tank with TWGSS installed and aligned, you will perform the following:

(1) Discuss troubleshooting procedures.
(2) Perform BIT initialization and discuss failure information.
(3) Conduct troubleshooting (PE).

c. **Procedure.** During this block of instruction we will cover TWGSS troubleshooting procedures. After this lesson, you will be able to troubleshoot and correct failures that may have occurred. You will have an assistant instructor for the practical exercise portion of this class.

8-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE. (60 minutes)

Notes. 1. The primary instructor will release the student crews to their assigned assistant (small group) instructor for the practical exercise portion of this lesson.
2. Show Slide 3.

a. **General Troubleshooting Procedures.**

(1) Verify that tank is set up properly to perform the intended function. A round loaded, the gun armed, etc.
(2) Perform troubleshooting IAW Chapters 3 and 4 of TM-9-6920-709-12&P-1-2.
(3) Verify all cable connections within TWGSS and between TWGSS and tank.
(4) Check TWGSS components for visible damage.
(5) Have TWGSS trained troubleshooter or Training support center (TSC) replace components if needed.

Note. Show Slide 4.

Warning. Perform all corrective action with the vehicle master power switch in OFF position. Damage could occur to TWGSS or tank or personnel could be injured if cables are connected or disconnected with master power switched on.

Note. Show Slide 5.

8-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

b. **Built-In Test (BIT) Initialization.** BIT can be initiated in several ways. Error messages are presented on the control panel as a pop-up screen.

(1) **Automatic BIT.** BIT is automatically performed when power is switched on. Any failure during operation will be announced over the tank intercom together with an error pop-up on the control panel display screen.
(2) **Before and after simulation.** Each TWGSS component performs a BIT before and after a simulation. This is to ensure that the system can perform or has performed a correct simulation.
(3) **Manual initialization.** The operator can manually perform BIT by using the TEST menu of the control panel.

Note. Show Slides 6 and 7.

c. **Error Information.** There are two main types of error messages:

(1) **NO CONNECTION X UNIT.** This message is displayed when a unit does not respond during BIT. The probable cause may be a loose or damaged cable or an internal failure of the unit.
(2) **ERROR X UNIT.** This message is displayed when a unit has a sub-function failure. The error can normally be corrected by replacing the unit indicated.

Note. Show Slide 8.

d. **Error Presentation.**

(1) **Intercom announcement.** A voice over the intercom informs the operator when an error occurs. The intercom announcement only informs the crew to check the control panel. The control panel indicates which type of failure has occurred.
(2) **Pop-up screen on control panel.** When an error occurs within the system, this is indicated with a pop-up screen superimposed over the control panel menu.
(3) **Error list.** Errors in the system are also listed in the TEST menu ERROR LIST. Multiple errors can be presented if the list is scrolled using arrow pushbuttons of control panel.
(4) **Errors logged on TDRS memory card.** Errors detected in the system are logged on the TDRS memory card. Errors logged on the card include a failure number indicating the failed sub-component. This number assists Contractor Logistic Support (CLS) personnel in troubleshooting faulty components.

Note. Show Slide 9.

e. **Errors Not Covered by BIT.** Some failures are not detected by BIT. These errors must be identified through replacement comparison tests.

(1) **Transceiver unit output.** If the system does not give a result during normal operating conditions, replace the transceiver unit and perform a comparison test.

(2) **System accuracy.** The accuracy of the transceiver unit is not covered by BIT. If ammunition dispersion appears larger than normal, replace transceiver unit and compare results.

(3) **Tank interface.** Tank signals to the simulator are not monitored. TWGSS cannot distinguish between tank failure or TWGSS failure. If a function related to the tank is inoperable, troubleshoot the tank without TWGSS.

Note. Show Slide 10.

f. **LED Indications.** Some of the TWGSS components have light emitting diodes that can be of assistance during troubleshooting. The LEDs are located within the moisture indicators and indicate with a blinking indication that power is applied correctly. The following units indicate with a red LED.

Note. TBOS driver unit and TBOS video mixer unit ONLY indicate during simulation of a round or when the control panel is activated (i.e., during BIT).

(1) **Vehicle interface unit.** The vehicle interface indicates that 24 volts is correctly processed to the rest of TWGSS. The blinking indication is there if power is applied correctly. If illuminated constantly or not at all, a problem is likely to be found in TWGSS.

(2) **Target computer unit.** The target computer unit indicates that 24 volts is correctly processed within the unit. The blinking indication is there if power is correctly processed. If illuminated constantly or not at all, a problem is likely to be found in TWGSS.

(3) **TBOS driver unit.** The TBOS driver unit indicates that 24 volts is correctly processed within the unit. The blinking indication is there if power is correctly processed. If illuminated constantly or not at all, a problem is likely to be found in TWGSS. The unit will not indicate unless a round is simulated or the control panel is activated.

(4) **TBOS video mixer unit.** The TBOS video mixer unit indicates that 24 volts is correctly processed within the unit. The blinking indication is there if power is correctly processed. If illuminated constantly or not at all, a problem is likely to be found in TWGSS. The unit will not indicate unless a round is simulated or the control panel is activated.

(5) **Remote system interface (RSI) unit.** The RSI unit indicates that 24 volts is correctly processed within the unit. The blinking indication is there if power is correctly processed. If illuminated constantly, or not at all, a problem is likely to be found in TWGSS.

8-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

Notes. 1. The primary instructor now releases the student crews to their assigned assistant (small group) instructors for the practical exercise portion of this lesson.
2. Prior to students' arrival, ensure that an assistant instructor is assigned to each training station.
3. Direct students to their appropriate training station.
4. Each assistant instructor is to conduct a safety briefing for his small group IAW Appendix A.
5. Whenever possible, have the students serve as demonstrators during small group instruction. Have one student read the procedures while another student performs the task. To ensure all students get equal hands-on time, rotate the reading and performance responsibilities.
6. Select failures from Appendix B and introduce one failure at a time to the crew.
7. The assistant instructor discusses and clarifies the procedures as required and reinforces the training objective.

Warning. Ensure that gun is locked to turret roof, turret traverse lock is engaged, and GTD switch is set to MANUAL position prior to working under the gun.

Warning. Before disconnecting any TWGSS units/cables to introduce an error, ensure that the vehicle master power switch and turret power switch are in OFF position.

8-3. TEST. (20 minutes/test)

See Appendix C.

8-4. FINAL REVIEW. (5 minutes)

a. **Student Questions.**

Note. Show Slide 11.

b. **Summary of Main Teaching Points.**

(1) Troubleshooting procedures
(2) BIT initialization and failure information
(3) Practical troubleshooting

Note. Show Slide 12.

c. **Closing Statement.** This block of instruction has prepared you to understand troubleshooting procedures used with TWGSS. The knowledge gained in this lesson will help when troubleshooting a TWGSS with a malfunction.

APPENDIX A
TO LESSON PLAN 8

TROUBLESHOOTING

SAFETY

Listed general safety regulations are to be strictly enforced during the performance of this lesson.

1. Mount and dismount tank over left front fender.
2. Maintain three points of contact while on top of tank.
3. No smoking within 50 m of tank.
4. Do not go over or under gun tube.
5. Ensure LRF has eye-safe laser filter (ELF) installed and LRF is set to SAFE.
6. LASER SAFETY: Do not view transceiver unit with optics from a distance of 25 m or closer.
7. Ensure gun/turret/drive (GTD) switch is set to MANUAL position during troubleshooting and before leaving turret.
8. Ensure main gun is locked to turret roof and turret traverse lock is engaged prior to working under gun.
9. Ensure vehicle master power switch is in OFF position when troubleshooting.
10. Ensure turret power switch is in OFF position when troubleshooting.
11. Ensure turret utility power switch is in OFF position when troubleshooting.
12. No cables should be connected or disconnected by untrained personnel.

APPENDIX B
TO LESSON PLAN 8

TROUBLESHOOTING

LIST OF APPROVED ERRORS

1. Disconnect connector J1 of W1 cable from transceiver unit and leave inside transceiver unit fixture. Produces NO CONNECTION TRANSCEIVER UNIT.
2. Disconnect connector J1 of W2 cable from TBOS driver unit and leave inside protective bag. Produces NO CONNECTION TRANSCEIVER UNIT and NO CONNECTION TBOS DRIVER UNIT.
3. Disconnect W6 cable connector J1 from left-front retro detector unit. Produces NO CONNECTION RETRO DETECTOR UNIT L/F.
4. Disconnect W7 cable connector J3 from the TBOS driver unit and leave inside protective bag. Produces NO CONNECTION TBOS GAS UNIT.
5. Disconnect W10 cable connector J2 from expansion unit inside vehicle interface assembly. Produces NO CONNECTION LOADERS PANEL, NO CONNECTION CABLE ASSEMBLY W11, and NO CONNECTION LRF NODE ASSEMBLY.
6. Set TDRS memory card write protection switch in locked position. Produces MEMORY CARD WRITE PROTECTION SWITCH.
7. Disconnect W8 cable connector J3 from TBOS video mixer unit. Produces NO CONNECTION TBOS JUNCTION BOX.
8. Disconnect HDDU cable connector J2 from left-front retro detector unit. Produces NO CONNECTION HULL D. DETECTOR UNIT L/F.
9. Disconnect W11 cable connector J1 from LRF node assembly connector J1. Produces NO CONNECTION LRF NODE ASSEMBLY.

Note. The following errors are to be used for troubleshooting test.

10. Disconnect W1 cable connector J2 from TBOS driver unit and leave inside protective bag. Produces NO CONNECTION TRANSCEIVER UNIT.
11. Disconnect HDDU cable connector J2 from right-rear retro detector unit. Produces NO CONNECTION HULL D. DETECTOR UNIT R/R.
12. Set TDRS memory card write protection switch in locked position. Produces MEMORY CARD WRITE PROTECTION SWITCH.

APPENDIX C
TO LESSON PLAN 8

TROUBLESHOOTING

TEST ADMINISTRATION GUIDE

C-1. TASK.

Administer test, *Troubleshooting.*

C-2. CONDITIONS.

Given a fully operational M1A2 tank with BII and TWGSS installed, including induced malfunctions.

C-3. STANDARDS.

The crewman will troubleshoot TWGSS IAW TM 9-6920-709-12&P-1-2 to identify and correct the induced malfunctions within 15 minutes.

C-4. PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED.

a. Evaluator (one per test station)
b. M1A2 tank with BII and TWGSS installed (one per evaluator)
c. TM 9-2350-288-10-1/2 (one set per test station)
d. TM 9-6920-709-12&P-1-2 (one copy per test station)
e. Appendix B, List of Approved Errors (one copy per test station)
f. Scoring checklist of Appendix C (one copy for each crewman tested)

C-5. TEST PLANNING TIME.

Administrative time:	5 minutes
Test time:	15 minutes
TOTAL TIME (per crewman):	20 minutes

C-6. OTHER INFORMATION.

Before the crewman arrives, the evaluator will:

a. Ensure TM 9-2350-288-10-1/2 is available
b. Ensure TM 9-6920-709-12&P-1-2 is available
c. Have scoring checklist ready for crewman to be tested
d. Induce errors 10, 11, and 12 from Appendix B

C-7. INSTRUCTIONS TO STUDENT.

"The purpose of this test is to determine your ability to correctly troubleshoot TWGSS. You will have 15 minutes to complete all tasks. You must complete each step before beginning the next step. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED'. You may use TM 9-6920-709-12&P-1-2 during the test".

"Do you understand the requirements of this test?" (Answer questions)
"You may begin." (Start time)

TROUBLESHOOTING

Scoring Checklist

NAME _____ UNIT _____

GRADE _____ DUTY POSITION _____

	GO	NO GO
1. Error 10, NO CONNECTION TRANSCEIVER UNIT		
a. Used Table 3-2 in TM	_____	_____
b. Observed all Cautions and Warnings in TM	_____	_____
c. Troubleshoot IAW malfunction 15 in TM	_____	_____
d. Reconnected W1 cable to TBOS driver unit connector J2	_____	_____
e. Verified if fault was corrected	_____	_____
2. Error 11, NO CONNECTION HULL D. DETECTOR UNIT R/R		
a. Used Table 3-2 in TM	_____	_____
b. Observed all Cautions and Warnings in TM	_____	_____
c. Troubleshoot IAW malfunction 25 in TM	_____	_____
d. Reconnected HDDU connector J2 to RDU	_____	_____
e. Verified if fault was corrected	_____	_____
3. Error 12, MEMORY CARD WRITE PROTECTION SWITCH.	_____	_____
a. Used Table 3-2 in TM	_____	_____
b. Turned off master power during correction of fault	_____	_____

	GO	NO GO
c. Removed TDRS memory card from control panel	_____	_____
d. Placed write protection switch to UNLOCK position	_____	_____
e. Re-inserted TDRS memory card in control panel	_____	_____
f. Turned on vehicle master power	_____	_____
g. Verified if fault was corrected	_____	_____

	GO	NO GO	INITIALS
Crewman satisfactorily completed all requirements	_____	_____	_____

EVALUATOR _____ DATE _____

REMARKS _____

APPENDIX D
TO LESSON PLAN 8

TROUBLESHOOTING

VIEWGRAPHS